

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims

- 1 1. (previously presented) A method for sending data in a computer system,
2 comprising:
3 establishing an active connection adapted to send packets of data between a host
4 and a destination;
5 receiving from the destination a first window value representing a first quantity of
6 data packets;
7 sending packets of data from said host to said destination;
8 receiving an acknowledgment from said destination for each packet of data
9 received by said destination wherein said first window value represents a limit imposed
10 on said host by said destination on the quantity of data packets sent from said host to said
11 destination and lacking an acknowledgment of being received by destination;
12 limiting the number of packets sent by said host, but not acknowledged as
13 received by said destination, to a second quantity of data packets less than said first
14 window value wherein said second quantity represents a limit imposed by said host on
15 the quantity of data packets sent from said host to said destination and lacking an
16 acknowledgment of being received by destination and wherein said second quantity is a
17 function of the number of active connections of the host;
18 establishing a plurality of active direct memory access connections between said
19 host and a plurality of specified memory locations of a plurality of destinations;
20 sending a plurality of messages to specified memory locations of the destinations
21 of the direct memory access connections wherein each message comprises a plurality of
22 data packets;
23 receiving message acknowledgments, each message acknowledgment being sent
24 by a destination for each message received by the destination; and
25 establishing a plurality of message limits, each message limit imposing a separate
26 limit for each direct memory access connection on the quantity of messages sent from
27 said host to the specified memory location of the direct memory access connection
28 associated with the message limit and lacking a message acknowledgment of being

29 received by the destination of the direct memory access connection associated with the
30 message limit.
31

1 2. (original) The method of claim 1 wherein the connection is a Transmission
2 Control Protocol connection between the host and the destination and wherein said first
3 window value is a Transmission Control Protocol send window value.

1 3. (original) The method of claim 1 further comprising:
2 establishing a plurality of active connections between the host and a plurality of
3 destinations;
4 receiving from each destination a first window value representing a first quantity
5 of data packets for the connection;
6 sending packets of data from said host to each destination;
7 receiving an acknowledgment from each destination for each packet of data
8 received by each destination wherein the first window value of each connection
9 represents a limit imposed on said host by the destination of the connection on the
10 quantity of data packets sent from said host to the destination of the connection and
11 lacking an acknowledgment of being received by the destination of the connection; and
12 limiting the number of packets sent by said host to each connection, but not
13 acknowledged as received by the destination of each connection, to a second quantity of
14 data packets less than the window value of the connection;
15 wherein the second quantity of each connection which is less than the window
16 value of the connection is based, at least in part, on the number of active connections of
17 the host.

1 4. (original) The method of claim 2 wherein said host has a plurality of
2 Transmission Control Protocol connections, each Transmission Control Protocol
3 connection having a Protocol Control Block which stores a Transmission Control
4 Protocol send window value and a virtual window value less than said Transmission
5 Control Protocol send window value wherein each virtual window value limits the
6 number of packets sent by said host, but not acknowledged as received by the destination
7 of each Transmission Control Protocol connection, to a second quantity of data packets
8 defined by the virtual window value of the Transmission Control Protocol connection.

1 5. (original) The method of claim 3 further comprising,
2 in response to the destination reducing the size of the Transmission Control
3 Protocol send window value to a third quantity less than the second quantity, limiting the
4 number of packets sent by said host, but not acknowledged as received by said
5 destination, to a fourth quantity of data packets no greater than the reduced size of the
6 Transmission Control Protocol send window value.

1 6. (cancelled)

1 7. (previously presented) The method of claim 1 , wherein each direct memory
2 access connection includes a network interface between an application of said host and a
3 network connecting the host to the plurality of destinations and wherein said network
4 interface includes a queue for each direct memory access connection and adapted to
5 queue messages to be sent through the direct memory access connection associated with
6 each queue, and wherein said each sending of a message to specified memory location of
7 the destination of a direct memory access connection includes queuing the message in the
8 network interface queue associated with the direct memory access connection; and
9 wherein the queuing of messages in the network interface queue associated with a direct
10 memory access connection is suspended when the quantity of messages sent from said
11 host to the specified memory location of the associated direct memory access connection
12 and lacking a message acknowledgment of being received by the destination of the
13 associated direct memory access connection reaches the separate message limit imposed
14 on the direct memory access connection associated with the network interface queue.

1 8. (original) The method of claim 7, wherein the queuing of messages in the
2 network interface queue associated with a direct memory access connection is resumed
3 when the quantity of messages sent from said host to the specified memory location of
4 the associated direct memory access connection and lacking a message acknowledgment
5 of being received by the destination of the associated direct memory access connection is
6 less than the separate message limit imposed on the direct memory access connection
7 associated with the network interface queue.

1 9. (previously presented) The method of claim 8 wherein the packet sending
2 connection is a Transmission Control Protocol connection between the host and the

3 destination and wherein each direct memory access connection is a Remote Direct
4 Memory Access connection between the host and the destination of the direct memory
5 access connection and each message is a Remote Direct Memory Access message.

1 10. (previously presented) The method of claim 9 wherein said network interface
2 has a pool of empty messages which imposes a limit on the total quantity of messages
3 sent from said host to all the specified memory locations of all the direct memory access
4 connections and lacking a message acknowledgment of being received by the destination
5 of the associated direct memory access connection and wherein each message limit is less
6 than the network interface pool of empty messages.

1 11. (currently amended) The method of claim 1 ~~6~~ wherein each message limit is
2 based, at least in part, on the number of active direct memory access connections of the
3 host.

1 12. (currently amended) The method of claim 1 ~~6~~ further comprising changing
2 the size of a message limit of an active direct memory access connection prior to sending
3 at least one message through the associated direct memory access connection.

1 13. (currently amended) The method of claim 12 ~~6~~ wherein each message limit
2 is based, at least in part, on the number of active direct memory access connections of the
3 host.

1 14. (previously presented) The method of claim 1 further comprising changing
2 the size of the second quantity of packets limiting the number of packets sent by the host
3 but not acknowledged as received by the destination prior to sending at least one packet .

1 15. (previously presented) A system adapted to communicate with data storage
2 and a destination having memory locations, comprising:
3 a system memory;
4 a processor coupled to the system memory;
5 a network adaptor;
6 a data storage controller for managing Input/Output (I/O) access to the data
7 storage; and

8 a device driver executable by the processor in the memory, wherein at least one of
9 the device driver and the network adaptor is adapted to:

10 (i) establish an active connection adapted to send packets of data between
11 the system and a destination;

12 (ii) receive from a destination a first window value representing a first
13 quantity of data packets;

14 (iii) send packets of data from the system to said destination;

15 (iv) receive an acknowledgment from said destination for each packet of
16 data received by said destination wherein said first window value represents a
17 limit imposed on said system by said destination on the quantity of data packets
18 sent from said system to said destination and lacking an acknowledgment of being
19 received by destination;

20 (v) limit the number of packets sent by said system, but not acknowledged as
21 received by said destination, to a second quantity of data packets less than said first
22 quantity wherein said second quantity represents a limit imposed by said system on the
23 quantity of data packets sent from said system to said destination and lacking an
24 acknowledgment of being received by destination and wherein said second quantity is a
25 function of the number of active connections of the system;

26 (vi) establish a plurality of active direct memory access connections between said
27 host and a plurality of specified memory locations of a plurality of destinations;

28 (vii) send a plurality of messages to specified memory locations of the
29 destinations of the direct memory access connections wherein each message comprises a
30 plurality of data packets;

31 (viii) receive message acknowledgments, each message acknowledgment being
32 sent by a destination for each message received by the destination; and

33 (ix) establish a plurality of message limits, each message limit imposing a
34 separate limit for each direct memory access connection on the quantity of messages sent
35 from said host to the specified memory location of the direct memory access connection
36 associated with the message limit and lacking a message acknowledgment of being
37 received by the destination of the direct memory access connection associated with the
38 message limit.

39 .

1 16. (original) The system of claim 15, wherein the data storage comprises a
2 magnetic storage medium.

1 17. (previously presented) The system of claim 15, wherein the connection is a
2 Transmission Control Protocol connection between the system and the destination and
3 wherein said first window value is a Transmission Control Protocol send window value.

1 18. (original) The system of claim 15 wherein at least one of the device driver
2 and the network adaptor is further adapted to:
3 establish a plurality of active connections between the system and a plurality of
4 destinations;
5 receive from each destination a first window value representing a first quantity of
6 data packets for the connection;
7 send packets of data from said system to each destination;
8 receive an acknowledgment from each destination for each packet of data
9 received by each destination wherein the first window value of each connection
10 represents a limit imposed on said system by the destination of the connection on the
11 quantity of data packets sent from said system to the destination of the connection and
12 lacking an acknowledgment of being received by the destination of the connection; and
13 limit the number of packets sent by said system to each connection, but not
14 acknowledged as received by the destination of each connection, to a second quantity of
15 data packets less than the window value of the connection;
16 wherein the second quantity of each connection which is less than the window
17 value of the connection is based, at least in part on the number of active connections of
18 the system.

1 19. (original) The system of claim 17 wherein at least one of the device driver
2 and the network adaptor is adapted to establish a plurality of Transmission Control
3 Protocol connections, each Transmission Control Protocol connection having a Protocol
4 Control Block data structure which stores a Transmission Control Protocol send window
5 value and a virtual window value less than said Transmission Control Protocol send
6 window value wherein each virtual window value limits the number of packets sent by
7 said system, but not acknowledged as received by the destination of each Transmission

8 Control Protocol connections, to a second quantity of data packets defined by the virtual
9 window value of the Transmission Control Protocol connection.

1 20. (original) The system of claim 19 wherein at least one of the device driver
2 and the network adaptor is adapted to:
3 in response to the destination reducing the size of the Transmission Control
4 Protocol send window value to a third quantity less than the second quantity, limiting the
5 number of packets sent by said system, but not acknowledged as received by said
6 destination, to a fourth quantity of data packets no greater than the reduced size of the
7 Transmission Control Protocol send window value.

1 21. (cancelled)

1 22. (previously presented) The system of claim 15 , wherein at least one of the
2 device driver and the network adaptor is adapted to provide a queue for each direct
3 memory access connection and adapted to queue messages to be sent through the direct
4 memory access connection associated with each queue, and wherein in each sending of a
5 message to specified memory location of the destination of a direct memory access
6 connection, at least one of the device driver and the network adaptor is adapted to queue
7 the message in the queue associated with the direct memory access connection; and to
8 suspend the queuing of messages in the queue associated with a direct memory access
9 connection when the quantity of messages sent from said system to the specified memory
10 location of the associated direct memory access connection and lacking a message
11 acknowledgment of being received by the destination of the associated direct memory
12 access connection reaches the separate message limit imposed on the direct memory
13 access connection associated with the queue.

1 23. (original) The system of claim 22, wherein at least one of the device driver
2 and the network adaptor is adapted to resume the queuing of messages in the queue
3 associated with a direct memory access connection when the quantity of messages sent
4 from said system to the specified memory location of the associated direct memory
5 access connection and lacking a message acknowledgment of being received by the
6 destination of the associated direct memory access connection is less than the separate

7 message limit imposed on the direct memory access connection associated with the
8 network interface queue.

1 24. (previously presented) The system of claim 23 wherein the packet sending
2 connection is a Transmission Control Protocol connection between the system and the
3 destination of the packet sending connection and wherein each direct memory access
4 connection is a Remote Direct Memory Access connection between the system and the
5 destination of the direct memory access connection and each message is a Remote Direct
6 Memory Access message.

1 25. (original) The system of claim 24 wherein at least one of the device driver
2 and the network adaptor is adapted to provide a pool of empty messages which imposes a
3 limit on the total quantity of messages sent from said system to all the specified memory
4 locations of all the direct memory access connections and lacking a message
5 acknowledgment of being received by the destination of the associated direct memory
6 access connection and wherein each message limit is less than the pool of empty
7 messages.

1 26. (previously presented) An article of manufacture comprising a computer
2 readable storage medium having code executed by a processor for managing data
3 transmission through a network, wherein the article of manufacture causes operations to
4 be performed, the operations comprising:
5 establishing an active connection adapted to send packets of data between a host
6 and a destination;
7 receiving from a destination a first window value representing a first quantity of
8 data packets;
9 sending packets of data from a host to said destination;
10 receiving an acknowledgment from said destination for each packet of data
11 received by said destination wherein said first window value represents a limit imposed
12 on said host by said destination on the quantity of data packets sent from said host to said
13 destination and lacking an acknowledgment of being received by destination;
14 limiting the number of packets sent by said host, but not acknowledged as
15 received by said destination, to a second quantity of data packets less than said first
16 quantity wherein said second quantity represents a limit imposed by said host on the

17 quantity of data packets sent from said host to said destination and lacking an
18 acknowledgment of being received by destination and wherein said second quantity is a
19 function of the number of active connections of the host;
20 establishing a plurality of active direct memory access connections between said
21 host and a plurality of specified memory locations of a plurality of destinations;
22 sending a plurality of messages to specified memory locations of the destinations
23 of the direct memory access connections wherein each message comprises a plurality of
24 data packets;
25 receiving message acknowledgments, each message acknowledgment being sent
26 by a destination for each message received by the destination; and
27 establishing a plurality of message limits, each message limit imposing a separate
28 limit for each direct memory access connection on the quantity of messages sent from
29 said host to the specified memory location of the direct memory access connection
30 associated with the message limit and lacking a message acknowledgment of being
31 received by the destination of the direct memory access connection associated with the
32 message limit.

1 27. (original) The article of manufacture of claim 26 wherein the connection is a
2 Transmission Control Protocol connection between the host and the destination and
3 wherein said first window value is a Transmission Control Protocol send window value.

1 28. (original) The article of manufacture of claim 27 wherein the operations
2 further comprise:
3 establishing a plurality of active connections between the host and a plurality of
4 destinations;
5 receiving from each destination a first window value representing a first quantity
6 of data packets for the connection;
7 sending packets of data from said host to each destination;
8 receiving an acknowledgment from each destination for each packet of data
9 received by each destination wherein the first window value of each connection
10 represents a limit imposed on said host by the destination of the connection on the
11 quantity of data packets sent from said host to the destination of the connection and
12 lacking an acknowledgment of being received by the destination of the connection; and

13 limiting the number of packets sent by said host to each connection, but not
14 acknowledged as received by the destination of each connection, to a second quantity of
15 data packets less than the window value of the connection;
16 wherein the second quantity of each connection which is less than the window
17 value of the connection is based, at least in part, on the number of active connections of
18 the host.

1 29. (original) The article of manufacture of claim 28 wherein said host has a
2 plurality of Transmission Control Protocol connections, each Transmission Control
3 Protocol connection having a Protocol Control Block which stores a Transmission
4 Control Protocol send window value and a virtual window value less than said
5 Transmission Control Protocol send window value wherein each virtual window value
6 limits the number of packets sent by said host, but not acknowledged as received by the
7 destination of each Transmission Control Protocol connections, to a second quantity of
8 data packets defined by the virtual window value of the Transmission Control Protocol
9 connection.

1 30. (original) The article of manufacture of claim 28, wherein the operations
2 further comprise:
3 in response to the destination reducing the size of the Transmission Control
4 Protocol send window value to a third quantity less than the second quantity, limiting the
5 number of packets sent by said host, but not acknowledged as received by said
6 destination, to a fourth quantity of data packets no greater than the reduced size of the
7 Transmission Control Protocol send window value.

1 31. (cancelled)

1 32. (previously presented) The article of manufacture of claim 26, wherein each
2 direct memory access connection includes a network interface between an application of
3 said host and a network connecting the host to the plurality of destinations and wherein
4 said network interface includes a queue for each direct memory access connection and
5 adapted to queue messages to be sent through the direct memory access connection
6 associated with each queue, and wherein said each sending of a message to specified
7 memory location of the destination of a direct memory access connection includes

8 queuing the message in the network interface queue associated with the direct memory
9 access connection; and wherein the queuing of messages in the network interface queue
10 associated with a direct memory access connection is suspended when the quantity of
11 messages sent from said host to the specified memory location of the associated direct
12 memory access connection and lacking a message acknowledgment of being received by
13 the destination of the associated direct memory access connection reaches the separate
14 message limit imposed on the direct memory access connection associated with the
15 network interface queue.

1 33. (original) The article of manufacture of claim 32, wherein the queuing of
2 messages in the network interface queue associated with a direct memory access
3 connection is resumed when the quantity of messages sent from said host to the specified
4 memory location of the associated direct memory access connection and lacking a
5 message acknowledgment of being received by the destination of the associated direct
6 memory access connection is less than the separate message limit imposed on the direct
7 memory access connection associated with the network interface queue.

1 34. (previously presented) The article of manufacture of claim 33 wherein the
2 packet sending connection is a Transmission Control Protocol connection between the
3 host and the destination and wherein each direct memory access connection is a Remote
4 Direct Memory Access connection between the host and the destination of the direct
5 memory access connection and each message is a Remote Direct Memory Access
6 message.

1 35. (original) The article of manufacture of claim 34 wherein said network
2 interface has a pool of empty messages which imposes a limit on the total quantity of
3 messages sent from said host to all the specified memory locations of all the direct
4 memory access connections and lacking a message acknowledgment of being received by
5 the destination of the associated direct memory access connection and wherein each
6 message limit is less than the network interface pool of empty messages.

1 36. (currently amended) The article of manufacture of claim 26 ~~34~~ wherein each
2 message limit is based, at least in part, on the number of active direct memory access
3 connections of the host.

1 37. (currently amended) The article of manufacture of claim 26 ~~34~~ further
2 comprising changing the size of a message limit of an active direct memory access
3 connection prior to sending at least one message through the associated direct memory
4 access connection.

1 38. (currently amended) The article of manufacture of claim 37 ~~34~~ wherein each
2 message limit is based, at least in part, on the number of active direct memory access
3 connections of the host.

1 39. (previously presented) The article of manufacture of claim 26 further
2 comprising changing the size of the second quantity of packets limiting the number of
3 packets sent by the host but not acknowledged as received by the destination prior to
4 sending at least one packet .